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IN SEARCH OF INDEPENDENT VARIABLES BEYOND SPEED: FIVE FACTORS OF AFFECTING NETWORK USER SATISFACTION

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Abstract

The number of people who connect to the network like the Internet has tremendously increased since the early 1990s. This research is intended to find the factors that could affect the user satisfaction of the network system connecting people. The results from a survey suggest that even though speed is still the most important factor in determining the quality of a network system, network managers consider four other factors such as connectivity, compatibility, security, and technical support.

Introduction

The trend toward globalization and competitive advantage is increasing the importance of international data communication through the network (which means computer network system in this article). Wrobel (1995) asserts that the network is a strategic asset to U.S. information processes and must be exploited to enhance the global posture of the U.S. Steinbart (1992) shows that firms that use their networks to exchange data with outside parties such as customers or suppliers are more satisfied with their networks than are firms that only exchange data internally. From this point of view, it is firmly believed that such networks are critical to their company's success. In other words, the more companies attempt to be globalized and competitive, the more critical the problems of the computer networks are.

In fact, network systems have been recognized as a main pillar of IT (information technology) infrastructure. Many authors (e.g., Duncan 1995; Keen 1991; Niederman et al. 1991) assert that the sharing, availability, and implementation of IT resources are the important functions of IT infrastructure. Based on the results of a delphi survey in 1994-95, Brancheau and his colleagues (1996) show that the computer network system is a very important part of information systems. Furthermore, the tremendous growth of electronic markets indicates that the network system is going to convey almost all traditional forms of commerce.

We believe that a network system should be approached not by its suppliers, but by the perspective of its consumers. Through the survey of 250 U.S. corporate telecommunications customers, Andersen Consulting found that telecom customers are generally satisfied with most aspects of network products quality, but they have complaints about areas that fall under the customer service heading (Burgess 1990). Network for the future must provide traffic capacity and service quality tuned to the needs of individual applications (Sultan & Basso 1995). In short, we need to understand how the network users are satisfied. Therefore, the purpose of this study is to develop a dimension that captures the aspects of network satisfaction that are important to network users. To this end, five factors are found from the previous studies, and a survey questionnaire is administered at students who are using the Internet by way of SLIP-PPP (Serial Line Internet Protocol – Point-to-Point Protocol).

Research Framework

Very few articles have attempted to develop the network satisfaction attributes. Lefavi (1995) asserts that systems managers must develop both meaningful and manageable network indicators, i.e., circuit availability, response time, and network congestion.

But this is focusing not on the network service but rather on the hardware quality. Booker (1987) has already reported that network quality and ancillary services are becoming at least as important as price. About ten years later, Mayer (1995) reports that the telecommunications managers who were asked to consider the ten most important attributes for selecting a network service provider considered network quality and reliability as the most important attributes closely followed by customer service. These studies lead us to get to the assumption that many factors can influence the network systems on users' satisfaction. From the literature review, we found five factors, as shown in Figure 1, that serve as independent variables that determine how satisfied a user has been in using the Internet server.

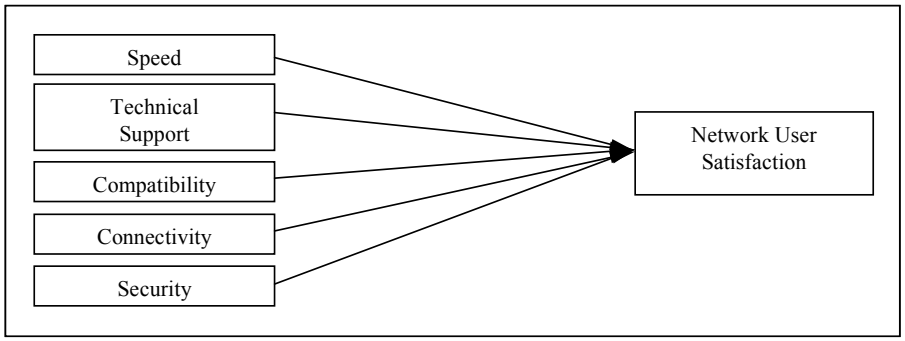

Figure 1. Research Framework

Speed

It is needless to say that of the dimensions determining the performance of network quality, speed has been recognized as the most important and critical factor. There are many articles that show the speed is a very important factor in a network system (Baley 1988; Lefavi 1995; Matta & Boutrous 1989; Mhoon 1987; Papa & Papa 1992). For example, Tucker (1994) addresses that because time can be spent accessing multiple information sources at high speeds, more time is available for further productive work. But the more important thing is that speed is just one of the factors contributing to satisfying network users. Kerr (1995) reports that increasing the network speed may introduce new bottlenecks, mainly because servers and workstations are underpowered for the faster speeds such as ATM (Asynchronous Transfer Mode) and Fast Ethernet. Furthermore, Dempsey and Koff (1995) assert that, although speed is desirable, it is never as important as quality, which means the richness of functional capabilities. In fact, speed has had a close relation to the prices of network products: the more expensive a product is, the faster it is. It is a common sense that switching from 10BaseT Ethernet to ATM or Fast Ethernet requires a considerable amount of capital resource. Based on the data gathered in a field study of 137 multi-line adjusters in a district office of an insurance company during the introduction of a new computer system, a multiple regression analysis shows significant positive relationships between three network factors (network diversity, size, and integrativeness) and the speed with which employees adopted an unofficial but effective way of using a new computer system (Papa & Papa 1992). Even these days, the close relationship between the price and the speed of network product still exists. So far as the price of network products does not go down to the extent that the users can ignore it, it seems that speed keeps its position as a very important factor in determining the network satisfaction.

Technical Support

Products and technologies just come and go: high-quality networks today may become low-quality networks tomorrow. The concept of the network requires the fast, satisfactory support from technicians when problems occur. Taff (1992) also reports that network quality can be strengthened by reducing the bit error rates and repair intervals. Satisfying the network users' needs requires a continual focus on the follow-up of network systems and operational processes. Real network management involves identifying potential problems before they happen (Dalzell 1988). Also, in essence, ease of use is a dimension of accessibility since users apparently do not perceive sources or channels to be accessible if they are difficult to use, and ease of use has been found to be an important factor in studies of electronic communications (Abels et al. 1996). Easily available, user-friendly tools are available to enable network users to capture and view data as it is broadcast around the local area network (Adams & Pappa 1995). In short, how easily users can connect to the server is another requirement from network users.

Compatibility

Steinbart (1992) asserts that most of the technical problems related to network revolve around hardware and software compatibility issues. He also reports that a company in the process of establishing links with its network users provides its major users with the necessary software to affect those links because it anticipates that the improved quality of service, which is possible with the company network, would both increase its overall level of network service and also improve data processing efficiency.

In addition, Duncan (1995) argues that information systems capabilities depend on platform compatibility. For instance, compatibility of hardware, operating systems, and network determine the transportability of systems across platforms, and transportability affects the cost and feasibility of changing processes, distributing systems, or reusing parts of systems in new ways. Network complexity sets in motion a chain of events that ripples out of the network group and into nearly all IT departments and business centers, including sales, marketing, engineering, and other groups. Based on the study of 10 larger companies, Strategic Networks Consulting Inc. shows that network complexity is threatening to drive up the cost of network service while undermining quality (Morency et al. 1995). Integrity also can be included in this category. Multimedia network integrates voice, data, text, and video, and allows dissimilar devices to exchange these various forms of information.

In addition, time zone and language differences are mentioned as being problems associated with quality of global networks (Steinbart 1992). They, however, are not considered as major problems: rather, they are considered as nuisances that make communication less sharable. For example, we have to be careful in specifying the date when sending electronic memos across the International Date Line. But, if network software supports these functions without users' paying attention, it will be considered "good quality".

Connectivity

Connectivity means not only the possibility of accessing to a network but also the state of connection or link after a user gets access to the network. Accordingly, within itself, the connectivity is including accessibility. The meaning of network accessibility includes mobility (Nasreldine 1995). For example, if a salesperson is moving from one part of an area to another, quite often, his/her network connections should remain "live" both during and after the move. Recently, product flow is separated from the market transactions by connecting the central computer with terminals at member traders' locations using communication networks (Lee & Clark 1996). This reflects the importance of the stable network connection. A network is not a thing that a man or woman uses alone in a specific country. It should be shared by countless users. A survey study shows that there is more intense use when there are fewer people sharing the workstation (Abels et al. 1996). The number of people sharing the network is another important attribute influencing adoption of the network. A couple of authors reported a decrease in perceived accessibility resulting from shared terminals (Steinfield 1986; Cook & Ridley 1990). Sharability can be regarded as a factor in determining the user satisfaction.

In choosing the intranet/extranet solutions (Turner 1997) and wireless local loop system (Levin et al. 1996), the enterprise IT strategists consider the basic network connectivity as the first criteria. Unless a hot standby server is implemented, network users may notice the absence of the service, for example, when the network server goes down (planned or unplanned). Users may interpret this as a lack of commitment to quality service or as an indication of weak technical capabilities (Poore 1995). We need to listen to Rice (1994)'s assertion that network connections establish resources and project procedures, technical knowledge, socialization patterns, and impressions that continue later on to influence performance ratings in spite of changing relationships.

Security

The importance of network security has been increasing tremendously in recent years. The ultimate purpose of network security is to keep data or information from those users' accesses without rights. Many members of Internet servers are suffering from unknown e-mails every day. If a user believes that an Internet server exposes his/her personal information such as e-mail address, and a telephone number, he/she may not continue to use the server. Information security, historically, has been a stepchild of the information technology revolution (Miller 1996). As transferring data through the network increases tremendously, network technology is taking over the responsibility of information security in recent years. Network security professionals have an obligation to help management assess the true business advantage of open network access versus the true costs of such access (Poore 1995). Furthermore, in an EDI environment, security must expand beyond an organization's internal boundaries to include its trading partners, because certain control techniques require their direct participation (Zoladz 1995). Security must be an important factor in determining the service quality of network systems.

Data

Based on the five dimensions and some demographic questions, a survey questionnaire was developed. Subjects were 59 students majoring in business school at a large state university. Because this study itself was about the Internet, the questionnaire was designed for a web survey (http://www.angelfire.com/mo/cklee/survey.html). The subjects were asked to visit the web site and fill out the survey form that was programmed to be sent directly to the researcher. A brief description on the subjects is shown in Table 1.

Table 1. A Demographic Description of Subjects

		Frequency	Mean	Std. Deviation
Sex	Male	14	N/A	N/A
	Female	45		
Age	19	13	20.47	1.2506
	20	19		
	21	20		
	22 -	7		
Grade	Freshman	1	N/A	N/A
	Sophomore	30		
	Junior	24		
	Senior	4		
Hour per Day	0	12	1.6102	1.3898
	1-2	37		
	3-4	6		
	5-6	4		

Because of the small sample size, both sex and age are quite skewed as shown in Table 1. Most subjects were at the level of sophomore or junior. Further, because subjects who responded 0 hour per day in using the Internet at home are still believed to use it somewhere else like computer lab on campus, they are assumed to be network users who are able to understand the survey questions.

Results

Data were analyzed by two-step statistical tests: factor analysis and multiple regression. First, for each independent and dependent variable, factor analysis is applied to see if the grouped questions are good representatives of each of the independent variables and can be treated as one factor. Second, multiple regression is applied to analyze the relationship between the five independent variables and the dependent variable.

Factor Analysis

Factor analysis is commonly used to reduce a set of variables into underlying factors that are generally linear combinations of the original variables. Because such variables as technical support, speed, and connectivity, composed of several questions, each of these variables is reduced into one factor. However, not all questions of these variables were included in the factor analysis because some questions like a question of technical support and a question of connectivity were not related to the users' satisfaction. These questions served to identify the frequencies of happenings with regard to the variable.

Table 2. Factor Analysis of Three Dimensions

Factor	Loading Value	Eigen Value	% of Variance
Technical Support	.802	1.286	64.298
Speed	.969	1.877	93.871
Connectivity	.902	1.629	81.441

As shown in Table 2, the factor analysis of three variables that have two more questions shows all eigen-values are bigger than 1.0, and percent of variance are larger than 60%. Also the five sub-variables have factor loading values of more than 0.8. In light of statistical measures such as loading value, eigen value, and percent of variance, all corresponding questions are good representatives of each factor as an independent variable.

Multiple Regression

The results of estimating the regression model are shown in Table 3 in line 1. The regression is highly significant and explains 39.7 percent of the cross-section variation in user satisfaction. The regression shows that user satisfaction is positively associated with technical support with B = 0.306 and network speed with B = 0.294. Other three variables are shown statistically insignificant at 95 percent significant level.

Table 3. Estimated Regressions of User Satisfaction on Independent Variables

Model	Constant	Tech	Speed	Connectivity	Compatibility	Security	R^2	F
(1)	3.842 (0.0001)*	0.306 (0.020)	0.294 (0.043)	0.0183 (0.879)	0.147 (0.108)	0.00037 (0.996)	0.397	6.987 (0.0001)
(2)	3.664 (0.0001)	0.397 (0.002)	-	-0.0288 (0.813)	0.225 (0.010)	-0.0382 (0.562)	0.348	7.218 (0.0001)

* p-values are shown in parentheses under estimated values of the regression coefficients.

The matrix of simple correlation coefficients among regression variables is shown in Table 4. The speed and compatibility have a correlation coefficient of 0.504. This correlation may have distorted the relationships. To see this effect, the speed variable is omitted from the complete model and the regression is re-estimated. This result is shown in line (2). When speed is omitted as an explanatory variable, the compatibility turns out to be statistically significant, which implies that the high correlation between speed and compatibility distorted the regression results in the complete model. The significant constant (3.842) and low R^2 indicate that some important variables that explain other 60.3% of the cross-section variation are missing.

Table 4. Matrix of Simple Correlation Coefficients of Regression Variables

	Satisfaction	Tech	Speed	Connectivity	Security	Compatibility
Satisfaction	1.000	0.502	0.534	-0.269	-0.043	0.446
Tech		1.000	0.471	-0.396	0.035	0.319
Speed			1.000	-0.382	-0.205	0.504
Connectivity				1.000	0.030	-0.263
Security					1.000	0.025
Compatibility						1.000

These findings imply that although we have believed that speed is a major consideration for designing network systems, network designers should take into account more constructs, such as technical support and compatibility. As the price of network products will drop, speed is gradually expected to lose its position as a very important factor in determining user satisfaction. These findings suggest that other dimensions that can affect user satisfaction also be seriously considered.

Limitations

Some limitations due to research design and other bias should be clearly mentioned to help future researchers have more accurate results.

First, because the population of this study is the Internet users at home, the samples of 59 students were definitely not enough. Although students were the most convenient subjects that could be contacted, it is strongly recommended that future researchers get the subjects from company employees who work mostly at home. Because today's companies rely on many virtual, mobile workers, satisfying those workers will be a very important issue for network managers.

Second, an intuitive approach was used to identify the five original dimensions of network satisfaction, even though the five dimensions are based on literature review. The advantage of using the intuitive approach is that each study can select the attributes most relevant to the particular goals of that study. Thus, it is possible that besides the five dimensions, another significant dimension exists. In this view, Wang and Strong (1996) point out that the intuitive approach tends to focus on the product and eventually may fail to capture the voice of the user. In addition, measuring the importance of each network user need was excluded in this study, because this study focuses only on identifying the dimensions of network satisfaction. We believe that measuring the importance of each network user need is going to be treated by future researchers.

Conclusions

Information systems managers must understand the dimensions and the dynamic nature of network quality to effectively use network resources as a product. Specifically, to effectively monitor day-to-day performance, network managers must develop meaningful network indicators that provide an accurate snapshot from the user's perspective.

The purpose of this study was to develop a snapshot that captures the aspects of network satisfaction that are important to network users. The meaningful network indicators that quality networks meet include at least two dimensions, technical support and speed. Further, as the price of network products decreases to help provide faster speed, it is expected that other dimensions, such as connectivity, compatibility, and security, will be increasingly important in the near future. These dimensions can help future researchers identify the attributes of network quality and help information systems managers understand network quality from the view of network users.

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